Seminar Proposal
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Compressed Sensing: Theory, Algorithms, and Applications to Imaging Systems

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Compressed sensing represents an emerging paradigm shift for the capture of a broad range of signals including images. Unlike traditional sampling that is based on the legendary Nyquist rate, compressed sensing (or *compressive sampling*) provides a new framework for capturing signals at lower rates, and hence, opening the door for power and storage savings for future capturing devices. Compressive sampling is achievable due to intrinsic signal characteristics such as sparsity and compaction. In essence, compressed sensing maps a sparse signal (x) onto a lower-dimension signal (y) using a linear system: $y = P\,x$, where P is known as the projection matrix.

The proposed seminar will cover the significant aspects of the theory, algorithms and applications of compressed sensing. Overall, the proposed seminar will consist of three parts:

(A) In the first part, the foundations of and fundamental theorems beyond compressed sensing will be outlined. This includes an overview and high-level coverage of seminal contributions in the area, popular projection models, and leading algorithms for signal reconstruction needed for solving the underdetermined linear system: $y = P\,x$.

(B) Since compressive sampling is based on *projections* of the original signal into a set of observations with lower dimension, the interplay between signal projections and the algorithms used for signal reconstruction will be highlighted as well.

(C) The final part of the proposed seminar will cover new directions in compressed sensing that provides significant reductions in complexity and/or in the number of samples required for perfect reconstruction. Examples of compressed sensing of images will be illustrated. Finally, the talk will conclude by outlining applications of compressed sensing to imaging systems. This includes new approaches for casting digital imaging under the well-known Color Filter Array (CFA) and related demosaicing problem onto a compressed sensing framework. Other applications to be outlined from a compressed-sensing perspective include super-resolution imaging and image deblurring.